

SPINAL ANATOMY

Osteology & Arthrology

AIM...

- By the end of these sessions we hope that you will be able to:
 - Identify the kinesiology of the axial skeleton
 - Explain the articulations and arthrokinematics of the different sections of the axial skeleton
 - Apply the function of the axial skeleton to prevention, injury assessment and rehabilitation.

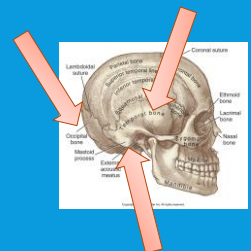
GENERAL TERMINOLOGY

- Dorsal – posterior or back of the body
- Ventral – anterior or front of the body
- Medial – towards midline of the body
- Lateral – away from the midline of the body
- Cephalad or cranial – superior direction towards the head or top of the body
- Caudal or caudal – inferior direction towards the tail or bottom of the body



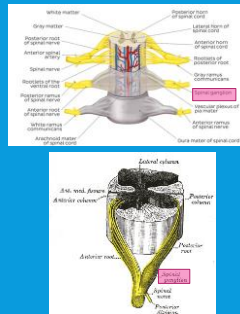
GENERAL ANATOMY

- Lets start at the top
- Cranium
 - Encases and protects the brain and sensory organs
 - Eyes, ears, nose, vestibular system
 - Temporal bone, occipital bone and mastoid process have articulations or attachments to spine



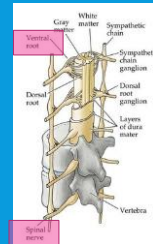
VENTRAL AND DORSAL NERVE ROOTS

- Dorsal (posterior) root is afferent nerve and transmits sensory information in to the CNS
 - Arrives
 - Passes through the dorsal root ganglion
 - Lateral – pain & temperature
 - Medial – touch, pressure, vibration, conscious proprioception from S5 to C2
- Ventral (anterior) root is the efferent motor root of the spinal nerve
 - Exit



EXITING SPINAL NERVE ROOTS

- Spinal nerve encompasses dorsal and ventral roots –
 - Mixed nerves
 - Become peripheral nervous system
- 31 pairs of spinal nerves
 - One on the left, one on right
- Grouped according to region
 - Cervical spine (8)
 - Thoracic (12)
 - Lumbar (5)
 - Sacral (5)
 - Coccygeal (1)

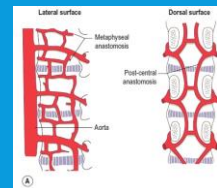


SPINAL NERVE ROOTS

- | | |
|--|--|
| <ul style="list-style-type: none"> Dermatomes <ul style="list-style-type: none"> An area of skin supplied by a single pair of dorsal roots Myotomes <ul style="list-style-type: none"> Group of muscles innervated by a single spinal nerve root Reflexes <ul style="list-style-type: none"> Involuntary muscle contraction in response to a stimulus | <p>Dorsal Roots</p> <ul style="list-style-type: none"> Posterior Afferent (arrives) Sensory Dermatomes <p>Ventral Roots</p> <ul style="list-style-type: none"> Anterior Efferent (exit) Motor Myotomes |
|--|--|

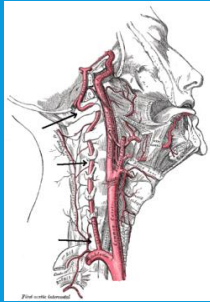
VERTEBRAL ARTERY AND SPINAL BLOOD SUPPLY

- Spinal cord
 - Anterior spinal artery
 - Posterior spinal arteries (R&L)
 - Sub-arachnoid space
- Vertebral column
 - Segmental blood supply
 - Cervical arteries
 - Costo-cervical & posterior intercostal arteries
 - Lumbar & ilio-lumbar arteries
 - Anastomose (connect) with and reinforce the anterior and posterior spinal arteries supplying the cord



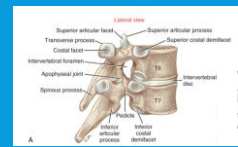
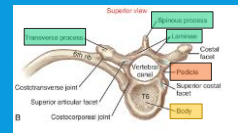
VERTEBRAL ARTERY AND SPINAL BLOOD SUPPLY

- Central subclavian artery on each side of body branches to form the vertebral artery at around C6/C7
- Transverse foramen of each vertebrae from c6- c2
- Kinks
- Moves from vertical direction to horizontal
- Enters the dura mater in to brainstem

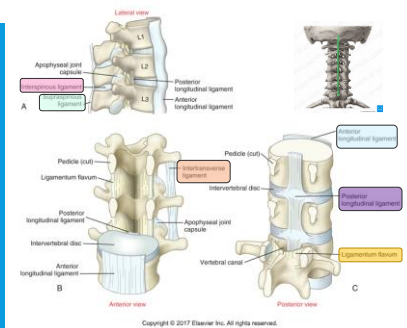


GENERIC VERTEBRAE

- Three sections
 - Anterior
 - Large vertebral body
 - Primary weight-bearing component
 - Posterior
 - Transverse and spinous processes
 - Laminae
 - Articular processes
 - Pedicles
 - Bridges that connect posterior and anterior elements
 - Thick & strong
 - Transfer muscle force applied to posterior elements for dispersion at the body and disc



GENERIC VERTEBRAE



GENERIC VERTEBRAE

Ligament	Description
Ligamentum Flavum	Yellow ligament Highly elastic 80% elastin Constant modest resistance through flexion - 35% strain
Interspinous ligaments	Fill deep space between adjacent spinous processes Deeper fibres blend with ligamentum flavum
Supraspinous ligaments	Attach between tips of spinous processes Resist flexion
Intertarsal ligaments	Poorly defined, thin structures that extend between adjacent transverse processes Resist side flexion and flexion
Anterior longitudinal ligament	Long, strong, straplike Basilar part of occipital bone to sacrum Deeper fibres blend with and reinforce the disc Resists extension & limits natural lordosis (Cosp & Lxsp)
Posterior longitudinal ligament	Entire length of the posterior of vertebral bodies between C2 and sacrum Inside vertebral canal anterior to cord Deeper fibres blend with and reinforce the disc Narrows as it descends Taut in flexion

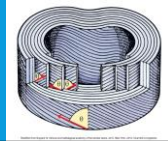
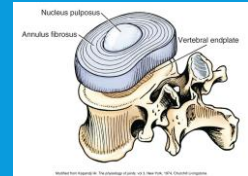
FACET JOINT CAPSULE

- Facet joint/apophyseal joint capsule
- Mostly collagen fibres
- Sensory mechanoreceptors embedded in capsule
 - Guiding IV movement
- Reinforced by multifidus muscle and ligamentum flava
- Strong – 1000N (225lb) of tension
- Loose in neutral
- Taut in EOR
- Which ROM depends on region of the spine



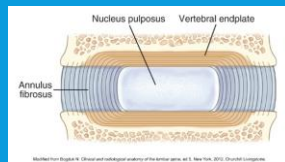
GENERIC INTERVERTEBRAL DISC

- Central nucleus pulposus
 - Pulp-like gel
 - Proteoglycans
 - 70-90% water
 - Modified hydraulic shock absorber
 - Transfer & dissipate force
- Annulus fibrosus
 - 15-25 concentric layers or rings of collagen fibres
 - Type I & II
 - Less type I in inner rings
 - 65° angle from vertical
 - Resistance from distraction, shear and torsion
 - In Cxsp annulus does not have complete rings – crescent



GENERIC INTERVERTEBRAL DISC

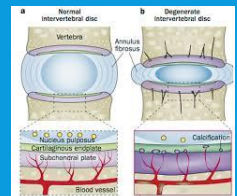
- Vertebral End Plates
 - Relatively thin cartilage caps of connective tissue
 - Cover superior and inferior surface of vertebral body
- Disc end: Fibrocartilage that binds with collagen in the annulus fibrosus
- Vertebral body end: calcified cartilage weakly attached to the bone
 - Weak link
 - Fracture under high compressive load
 - Allow leak of proteoglycan gel from nucleus pulposus – disc disruption
 - Lead to spinal instability



GENERIC INTERVERTEBRAL DISC

Blood Supply

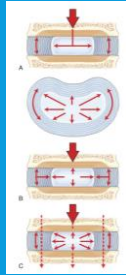
- Only outer most peripheral rings of the annulus fibrosus contain blood vessels
- Inherently limited capacity for healing
- O₂ & Glucose must diffuse a long way to reach the deeper cells and sustain disc's low but essential metabolism



- Aged discs have reduced permeability and increased calcification of the vertebral end plates
- Reduction in nutrients and oxygen to the disc
- Inhibits cellular metabolism & synthesis of proteoglycans
- Proteoglycans attract and hold water – load transfer

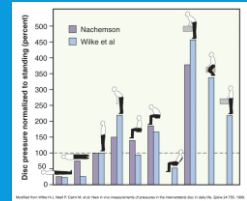
GENERIC INTERVERTEBRAL DISC

- Approximately 80% of load is transmitted through the interbody joint
- IVD uniquely designed shock absorbers
 - Protect bone from excessive pressure
- Viscoelastic properties
 - IVD resists fast/strongly applied compression more than slow/light compression
 - Flexible at low loads
 - Rigid high loads



GENERIC INTERVERTEBRAL DISC

- Nucleus pulposus pressures in vivo 70kg adult
- Much larger disc pressures from flexing
- Extension reduces disc pressure
 1. Disc pressures are larger when holding a weight in front of body esp. in flxn
 2. Lifting a load with knees flexed places less pressure on the disc
 3. Sitting forward in a slouch produces greater disc pressure than sitting upright



NEXT STEPS

- Take time to digest the generic anatomy
- Cxsp
- Txsp
- Lxsp
- SIJ
- Subjective assessment
- Common MSK injuries
- Red Flags & Masquerades

